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(PATENT)

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In re Patent Application of:
Masahiko AKUTSU et al.

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Art Unit: N/A

For: LIQUID CRYSTAL DISPLAY DEVICE,
SIGNAL PROCESSING UNIT FOR USE IN
LIQUID CRYSTAL DISPLAY DEVICE,
PROGRAM AND STORAGE MEDIUM
THEREOF, AND LIQUID CRYSTAL
DISPLAY CONTROL METHOD

Examiner: Not Yet Assigned

LETTER

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The PTO is requested to use the amended sheets/claims attached hereto (which correspond to Article 19 amendments or to claims attached to the International Preliminary Examination Report (Article 34)) during prosecution of the above-identified national phase PCT application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §1.16 or 1.14; particularly, extension of time fees.

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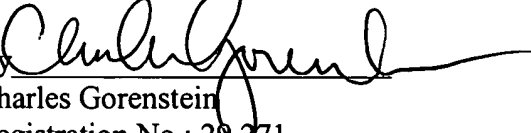
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Respectfully submitted,

By 

Charles Gorenstein

Registration No.: 29,271

BIRCH, STEWART, KOLASCH & BIRCH, LLP

8110 Gatehouse Road

Suite 100 East

P.O. Box 747

Falls Church, Virginia 22040-0747

(703) 205-8000

Attorney for Applicant

Attachment(s)

compensating for optical response properties of the liquid crystal display panel, the liquid crystal display device comprising: I/P conversion means which, when incoming video data is an interlaced signal, converts the interlaced
5 signal into a progressive signal in accordance with any one of two or more conversion methods; and emphasis conversion means which carries out emphasis conversion on video data of current vertical period so as to emphasize grayscale transition at least from previous vertical period to current vertical
10 period in the progressive signal, wherein a degree of the emphasis conversion on the video data is controlled so as to be changed in accordance with which kind of conversion method among the two or more conversion methods is used for the conversion.

15 Note that mutually different conversion methods are conversion methods by which mutually different progressive video signals are outputted in response to identical interlaced video signals. For example, the mutually different conversion
20 methods are the ones which adopt mutually different algorithms or the ones which adopt identical algorithms but has different parameters and filter properties.

Examples of the mutually different conversion methods include (1) motion adaptive interlace/progressive conversion and (2) interlace/progressive conversion by intra-field
25 interpolation only (intra-field interpolation for all pixels

conversion. Thus, it is possible to perform grayscale transition emphasis with a suitable degree all the time whichever conversion method is used for generation of a progressive video signal. It is therefore possible to realize both improvement in response speed of the liquid crystal display device and improvement in quality of video image displayed on the liquid crystal display device.

In order to solve the above problems, a liquid crystal display device according to the present invention includes any one of the above-arranged signal processing units for use in a liquid crystal display device. As is the case with the above signal processing units for use in liquid crystal display device, it is possible to realize both improvement in response speed of the liquid crystal display device and improvement in quality of video image displayed on the liquid crystal display device.

Further, a liquid crystal display device according to the present invention is a liquid crystal display device having an I/P conversion means which, when incoming video data is an interlaced signal, converts the interlaced signal into a progressive signal in accordance with any one of two or more conversion methods, said liquid crystal display device, carrying out emphasis conversion on video data supplied to a liquid crystal display panel in accordance with at least video data of previous vertical period and video data of current vertical period, so as to emphasize grayscale transition at

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or more conversion methods is used for the conversion, the computer controlling a liquid crystal display device comprising: an I/P conversion means which, when incoming video data is an interlaced signal, converts the interlaced
5 signal into a progressive signal in accordance with any one of two or more conversion methods; and emphasis conversion means which carries out emphasis conversion on video data of current vertical period so as to emphasize grayscale transition at least from previous vertical period to current vertical
10 period in the progressive signal, and the liquid crystal display device carrying out emphasis conversion on video data supplied to a liquid crystal display panel in accordance with at least video data of previous vertical period and video data of current vertical period, thereby compensating for optical
15 response properties of the liquid crystal display panel. Another program according to the present invention is a program causing a computer comprising: conversion means which converts an interlaced video signal into a progressive video signal; and correction means which corrects a video
20 signal of a current vertical period so as to emphasize grayscale transition at least from current vertical period to previous vertical period in the progressive video signal, wherein the conversion means is capable of conversions by two or more conversion methods, to operate so as to change a
25 degree of grayscale transition

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of: when incoming video data is an interlaced signal,
converting the interlaced signal into a progressive signal in
accordance with any one of two or more conversion methods;
and carrying out emphasis conversion on video data of the
5 current vertical period so as to emphasize grayscale transition
at least from previous vertical period to current vertical
period in the progressive signal, wherein a degree of the
emphasis conversion on the video data is controlled so as to
be changed in accordance with which kind of conversion
10 method among the two or more conversion methods is used
for the conversion.

Further, in order to solve the above problems, a liquid
crystal display control method according to the present
invention is a liquid crystal display driving method
15 comprising: a conversion step of converting an interlaced
video signal into a progressive video signal; and a correction
step of correcting a video signal of current vertical period so
as to emphasize grayscale transition at least from current
vertical period to previous vertical period in the progressive
20 video signal, wherein conversions by two or more conversion
methods are possible in the conversion step, the method
further comprising: a control step of changing a degree of the
grayscale transition emphasis performed in the correction
step in accordance with a conversion method used in the
25 conversion step.

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Still further, in order to solve the above problems, a liquid crystal display control method according to the present invention is a liquid crystal display control method of including a conversion step of converting an interlaced video signal into a progressive video signal, and modulating the progressive video signal so as to emphasize grayscale transition in each pixel of a liquid crystal display device, wherein conversions by two or more conversion methods are possible in the conversion step, and a degree of the grayscale transition emphasis is changed in accordance with a conversion method used in the conversion step.

Yet further, in order to solve the above problems, a liquid crystal display control method according to the present invention is a liquid crystal display control method including an I/P conversion step of, when incoming video data is an interlaced signal, converting the interlaced signal into a progressive signal in accordance with any one of two or more conversion methods, said method carrying out emphasis conversion on video data supplied to a liquid crystal display panel in accordance with at least video data of previous vertical period and video data of current vertical period, so as to emphasize grayscale transition at least from previous vertical period to current vertical period in the progressive signal, thereby compensating for optical response properties of the liquid crystal display panel, wherein a

accessible to the computing means; or the program is stored before installing in a local storage medium from a network or a mobile storage medium.

5 In addition, the program is not limited to compiled object code. The program may be stored as source code or intermediate code generated in the course of interpretation or compilation. In any case, similar effects are obtained regardless of the format in which the storage medium stores the program, provided that decompression of compressed
10 information, decoding of encoded information, interpretation, compilation, links, or loading to an memory or combinations of these processes can convert into a format executable by the computing means.

15 Note that a liquid crystal display device according to the foregoing embodiments is a liquid crystal display device which carries out emphasis conversion on video data supplied to a liquid crystal display panel in accordance with at least video data of previous vertical period and video data of current vertical period, thereby compensating for optical response
20 properties of the liquid crystal display panel, the liquid crystal display device comprising: I/P conversion means which, when incoming video data is an interlaced signal, converts the interlaced signal into a progressive signal in accordance with any one of two or more conversion methods;
25 and emphasis conversion means which carries out emphasis

conversion on the video data having been subjected to the conversion so that the liquid crystal display panel provides a transmittance defined by the video data within a predetermined period, wherein a degree of the emphasis conversion on the video data is controlled so as to be changed in accordance with which kind of conversion method among the two or more conversion methods is used for the conversion.

A program according to the foregoing embodiments is a program causing a computer to execute a process of controlling a degree of emphasis conversion on video data so as to be changed in accordance with which kind of conversion method among two or more conversion methods is used for the conversion, the computer controlling a liquid crystal display device comprising: an I/P conversion means which, when incoming video data is an interlaced signal, converts the interlaced signal into a progressive signal in accordance with any one of two or more conversion methods; and emphasis conversion means which carries out emphasis conversion on the video data having been subjected to the conversion so that the liquid crystal display panel provides a transmittance defined by the video data within a predetermined period, and the liquid crystal display device carrying out emphasis conversion on video data supplied to a liquid crystal display panel in accordance with at least video data of previous

vertical period and video data of current vertical period, thereby compensating for optical response properties of the liquid crystal display panel.

Further, a liquid crystal display control method according to the foregoing embodiments is a liquid crystal display control method of carrying out emphasis conversion on video data supplied to a liquid crystal display panel in accordance with at least video data of previous vertical period and video data of current vertical period, thereby compensating for optical response properties of the liquid crystal display panel, the method comprising the steps of: when incoming video data is an interlaced signal, converting the interlaced signal into a progressive signal in accordance with any one of two or more conversion methods; and carrying out emphasis conversion on the video data having been subjected to the conversion so that the liquid crystal display panel provides a transmittance defined by the video data within a predetermined period, wherein a degree of the emphasis conversion on the video data is controlled so as to be changed in accordance with which kind of conversion method among the two or more conversion methods is used for the conversion.

Still further, a liquid crystal display control method according to the foregoing embodiments is a liquid crystal display control method of carrying out comparison at least

between video data of previous frame and video data of current frame, and performing emphasis conversion on video data supplied to a liquid crystal display panel in accordance with a result of the comparison, thereby compensating for optical response properties of the liquid crystal display panel, the method comprising the steps of: when incoming video data is an interlaced signal, converting the interlaced signal into a progressive signal in accordance with any one of two or more conversion methods; and carrying out emphasis conversion on the video data having been subjected to the conversion so that the liquid crystal display panel provides a transmittance defined by the video data within a predetermined period, wherein a degree of the emphasis conversion on the video data is controlled so as to be changed in accordance with which kind of conversion method among the two or more conversion methods is used for the conversion.

In addition to the above steps, the method may have: a step of referencing to a table memory which stores an emphasis conversion parameter determined by video data of current frame and video data of at least previous frame; a step of subjecting the video data to emphasis operation by using the emphasis conversion parameter; and a step of multiplying output data obtained by the emphasis operation by a different coefficient varying depending upon which kind of conversion method among the two or more conversion

CLAIMS

1. (Amended) A liquid crystal display device which carries out emphasis conversion on video data supplied to a liquid crystal display panel in accordance with at least video data of previous vertical period and video data of current vertical period, thereby compensating for optical response properties of the liquid crystal display panel,

the liquid crystal display device comprising:

I/P conversion means which, when incoming video data is an interlaced signal, converts the interlaced signal into a progressive signal in accordance with any one of two or more conversion methods; and

emphasis conversion means which carries out emphasis conversion on video data of current vertical period so as to emphasize grayscale transition at least from previous vertical period to current vertical period in the progressive signal,

wherein a degree of the emphasis conversion on the video data is controlled so as to be changed in accordance with which kind of conversion method among the two or more conversion methods is used for the conversion.

2. The liquid crystal display device according to claim 1, further comprising:

table memory which stores an emphasis conversion

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conversion means which converts an interlaced video signal into a progressive video signal and modulating the progressive video signal so as to emphasize grayscale transition in each pixel of the liquid crystal display device,

5 wherein the conversion means is capable of conversions by two or more conversion methods, and

 a degree of the grayscale transition emphasis is changed in accordance with a conversion method used by the conversion means.

10

24. A liquid crystal display device including the signal processing unit according to any one of claims 11 through 14 and claim 23.

15

25. (Amended) A liquid crystal display device having an I/P conversion means which, when incoming video data is an interlaced signal, converts the interlaced signal into a progressive signal in accordance with any one of two or more conversion methods,

20

said liquid crystal display device, carrying out emphasis conversion on video data supplied to a liquid crystal display panel in accordance with at least video data of previous vertical period and video data of current vertical period, so as to emphasize grayscale transition at least from previous vertical period to current vertical period in the progressive

25

signal, thereby compensating for optical response properties of the liquid crystal display panel, and

controlling a degree of the emphasis conversion on the video data so as to be changed in accordance with which kind of conversion method among the two or more conversion methods is used for the conversion.

26. (Amended) A program causing a computer to execute a process of controlling a degree of emphasis conversion on video data so as to be changed in accordance with which kind of conversion method among two or more conversion methods is used for the conversion,

the computer controlling a liquid crystal display device comprising: an I/P conversion means which, when incoming video data is an interlaced signal, converts the interlaced signal into a progressive signal in accordance with any one of two or more conversion methods; and emphasis conversion means which carries out emphasis conversion on video data of current vertical period so as to emphasize grayscale transition at least from previous vertical period to current vertical period in the progressive signal, and the liquid crystal display device carrying out emphasis conversion on video data supplied to a liquid crystal display panel in accordance with at least video data of previous vertical period and video data of current vertical period, thereby compensating for optical

response properties of the liquid crystal display panel.

27. A program causing a computer comprising:
conversion means which converts an interlaced video signal
5 into a progressive video signal; and correction means which
corrects a video signal of a current vertical period so as to
emphasize grayscale transition at least from current vertical
period to previous vertical period in the progressive video
signal, wherein the conversion means is capable of
10 conversions by two or more conversion methods,

to operate so as to change a degree of grayscale
transition emphasis performed by the correction means in
accordance with a conversion method used by the conversion
means.

28. A storage medium storing the program according to
claim 26 or 27.

29. (Amended) A liquid crystal display control method of
20 carrying out emphasis conversion on video data supplied to a
liquid crystal display panel in accordance with at least video
data of previous vertical period and video data of current
vertical period, thereby compensating for optical response
properties of the liquid crystal display panel,

25 the method comprising the steps of:

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when incoming video data is an interlaced signal,
converting the interlaced signal into a progressive signal in
accordance with any one of two or more conversion methods;
and

5 carrying out emphasis conversion on video data of the
current vertical period so as to emphasize grayscale transition
at least from previous vertical period to current vertical
period in the progressive signal,

10 wherein a degree of the emphasis conversion on the
video data is controlled so as to be changed in accordance
with which kind of conversion method among the two or more
conversion methods is used for the conversion.

30. (Amended) A liquid crystal display control method
15 comprising:

a conversion step of converting an interlaced video
signal into a progressive video signal; and

20 a correction step of correcting a video signal of current
vertical period so as to emphasize grayscale transition at
least from current vertical period to previous vertical period
in the progressive video signal,

wherein conversions by two or more conversion methods
are possible in the conversion step,

the method further comprising:

25 a control step of changing a degree of the grayscale

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transition emphasis performed in the correction step in accordance with a conversion method used in the conversion step.

5 31. A liquid crystal display control method of including a conversion step of converting an interlaced video signal into a progressive video signal, and modulating the progressive video signal so as to emphasize grayscale transition in each pixel of a liquid crystal display device,

10 wherein conversions by two or more conversion methods are possible in the conversion step, and

 a degree of the grayscale transition emphasis is changed in accordance with a conversion method used in the conversion step.

15

 32. (Amended) A liquid crystal display control method including an I/P conversion step of, when incoming video data is an interlaced signal, converting the interlaced signal into a progressive signal in accordance with any one of two or more conversion methods,

20

 said method carrying out emphasis conversion on video data supplied to a liquid crystal display panel in accordance with at least video data of previous vertical period and video data of current vertical period, so as to emphasize grayscale transition at least from previous vertical period to current

25

vertical period in the progressive signal, thereby compensating for optical response properties of the liquid crystal display panel, wherein

5 a degree of the emphasis conversion on the video data is controlled so as to be changed in accordance with which kind of conversion method among the two or more conversion methods is used for the conversion.